

REMARKS

Claims 15-34 are all the claims pending in the application. Claims 21-34 are added above to more broadly define the invention. Claims 15-20 stand rejected on prior art grounds. Applicants respectfully traverse these objections/rejections based on the following discussion.

I. The Prior Art Rejections

Claims 15-16 and 19-20 stand rejected under 35 U.S.C. §102(b) as being anticipated by Brady et al. (U.S. Patent No. 5,633,047), hereinafter “Brady”, and claims 17-18 stand rejected under 35 U.S.C. §103 as being unpatentable over Brady. Applicants respectfully traverse these rejections based on the following discussion.

A. The Examiner’s Position

With respect to the 35 U.S.C. §102 rejection of independent claim 15, the Office Action states that Brady discloses a substantially silicide free metallurgy (20), and an uppermost layer of metallurgy (22 & 24) including a bonding pad, wherein a top of the uppermost layer comprises a silicide surface (32). (See Col. 4, lines 22-36 and Col. 6, lines 46-55 of Brady). Regarding claim 16, the Office Action proposes that Brady discloses that the interconnecting metallurgy is copper (22). Regarding claim 19, the Office Action states that Brady discloses a lead or tin solder (34) terminal electrically connected to the silicide surface. Regarding claim 20, the Office Action offers that Brady discloses a silicon nitride (8) layer physically connected to the silicide and including an opening allowing direct electrical contact with the silicide surface.

With respect to the 35 U.S.C. §103 rejection of claims 17-18, the Office Action states that the cleaning in claim 17 is a product-by-process limitation and that it would have been an obvious matter of design choice to form the claimed structure, since such a modification would have involved a mere change in the shape of a component. Similarly, regarding claim 18, the

Office Action argues that the silicide surface comprising a top 10% or 20% of a thickness of uppermost layer is an obvious design choice, therefore held within ordinary skills in the art.

B. The Brady et al. Reference

Brady discloses silicon and germinium containing materials used in surface of conductors in electronic devices. Solder can be fluxlessly bonded and wires can be wire bonded to these surfaces. These materials are used as a surface coating for lead frames for packaging integrated circuit chips. These materials can be decal transferred onto conductor surfaces or electrolessly or electrolytically disposed thereon.

C. Applicants' Response

However, Applicants submit that Brady does not teach or suggest a silicide layer as in the claimed invention. To the contrary, as clearly stated in column 5, lines 40-45 of Brady, the layers 32 (28, 30), shown in Figures 3 and 4 of Brady, are not a silicide layer but instead are a copper germanide layer. These copper germanide layers are not functionally equivalent to a silicide layer. Therefore, Brady clearly does not teach or suggest that "a top of said uppermost layer comprises a silicide surface", as defined by independent claim 15.

More specifically, page 8, lines 12-21 of the application clearly describe the silicide process as one where nitrogen is flowed at 1500 sccm and SiH₄ is flowed at 15 - 180 sccm in a chamber having 2.6 Torr pressure and a temperature of approximately 400 °C. The processing is continued for a period of time sufficient to form silicide layer 13. This is fundamentally different than the process described in Brady column 5, line 39-41 where a germanium layer is deposited and then a copper layer is deposited. Therefore, Brady clearly does not teach or suggest the silicide surface defined by Applicants' claims.

Contrary to teaching or suggesting the claimed invention, Brady actually is an example of the structure that produced disadvantages that the invention is directed to avoid. More

specifically, the application, beginning on page 5, line 20 states that conventional solutions to this problem involve forming additional masking levels and patterning addition non-copper layers to reduce the stress between the copper and LM nitride. These solutions are costly, add significant cycle time and do not directly address the weak Cu-nitride interface which is responsible for the last metal delamination.

The invention reduces such delamination by forming the silicide layer over the last metalization layer to generally at least 10-20% the thickness of the LM layer. This extensive silicide formation is required at the last metal level to resolve the copper/nitrite adhesion issues. Also, the last metalization layer generally comprises very thick metallurgy, and is, therefore, substantially less sensitive to resistivity shifts. Thus, with the invention the resistivity problems noted with conventional copper silicide (CuSi) systems is avoided. The improved surface coverage provided by the invention enables less resistivity shift per percent thickness of LM layer formation.

Even though the invention forms the silicide layer thicker than the 10% limit which is known conventionally, the resistance problems are avoided because the last metalization layer 11 is substantially thicker than the metalization layers below in the underlying structure. These features are even more broadly defined in newly added independent claims 21 and 29. Therefore, Applicants respectfully submit that both the anticipation and the obviousness rejections are incorrect in that Brady does not teach or suggest a silicide layer.

In view of the foregoing, Applicants submit that independent claim 15 (and newly added independent claims 21 and 29) is not taught or suggested by Brady and is therefore patentable over the prior art of record. Further, dependent claims 16-20 (and newly added dependent claims 22-28 and 30-34) are similarly patentable, not only by virtue of their dependency from a patentable independent claim, but also by virtue of the additional features of the invention they define. Therefore, the Examiner is respectfully requested to reconsider and withdraw both the 35 U.S.C. §102 and §103 rejections of claims 15-20.

II. Formal Matters and Conclusion

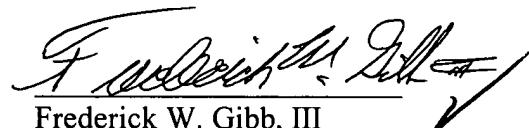
In view of the foregoing, Applicants submit that claims 15-20, all the claims presently pending in the application, are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary.

Please charge any deficiencies and credit any over payments to Attorney's deposit account number 09-0456.

Respectfully submitted,

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Frederick W. Gibb, III
Reg. No. 37,629

McGinn & Gibb, PLLC
8321 Old Courthouse Road, Suite 200
Vienna, VA 22182-3817
(703) 761-4100
Customer Number: 28211